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Control of Japanese Beetle in Lawns

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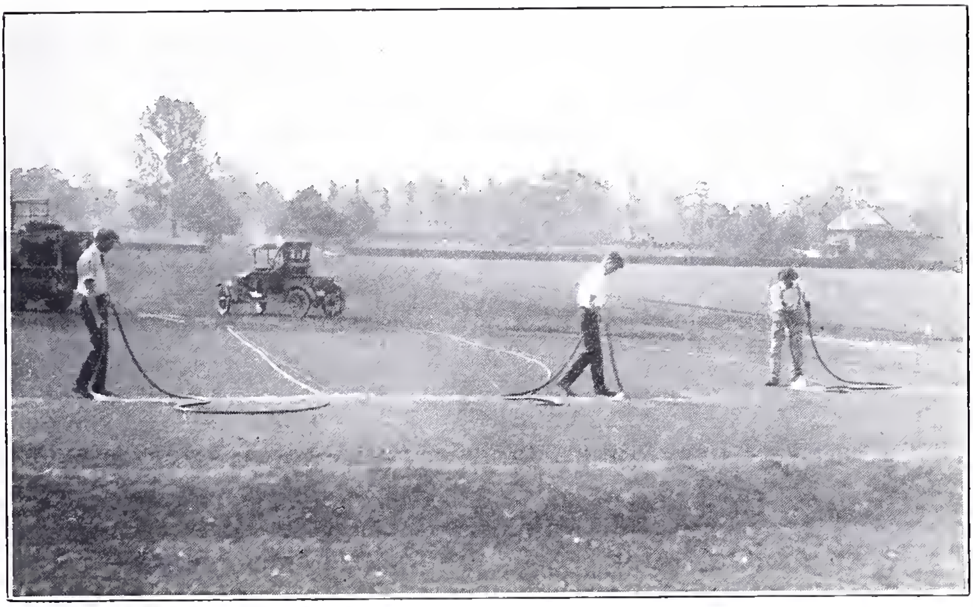

Applying Liquid to Lawn in Control of the Japanese Beetle

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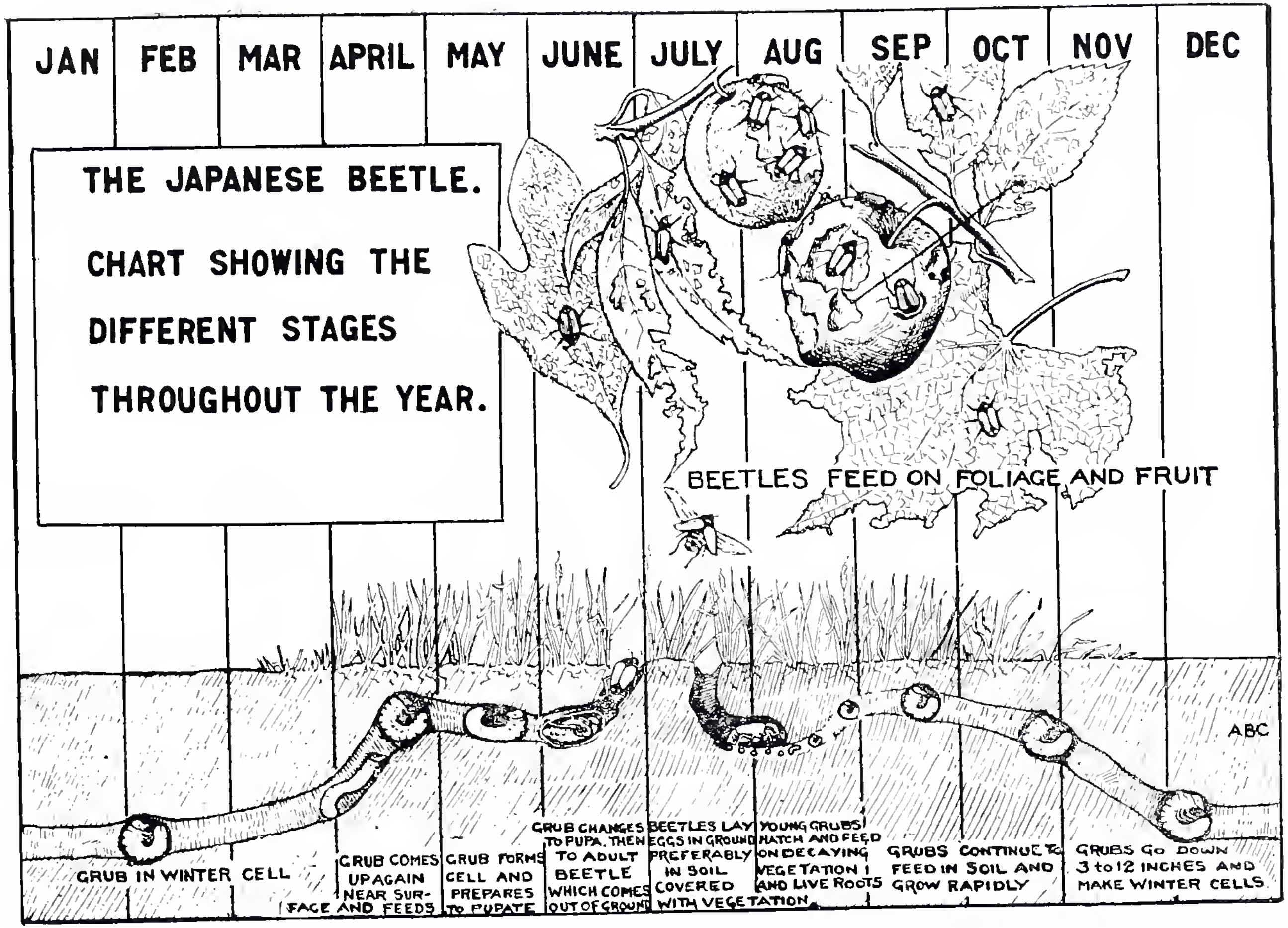
JAN
FEB
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THE JAPANESE BEETLE.
CHART SHOWING THE
DIFFERENT STAGES
THROUGHOUT THE YEAR.
BEETLES FEED ON FOLIAGE AND FRUIT
ABC
GRUB IN WINTER CELL
GRUB COMES UP AGAIN NEAR SURFACE AND FEEDS
GRUB FORMS CELL AND PREPARES TO PUPATE
GRUB CHANGES TO PUPA, THEN TO ADULT BEETLE WHICH COMES OUT OF GROUND
BEETLES LAY EGGS IN GROUND PREFERABLY IN SOIL COVERED WITH VEGETATION
YOUNG GRUBS HATCH AND FEED ON DECAYING VEGETATION AND LIVE ROOTS
GRUBS CONTINUE TO FEED IN SOIL AND GROW RAPIDLY
GRUBS GO DOWN 3 to 12 INCHES AND MAKE WINTER CELLS

Fig. 1. Diagrammatic illustration of the life-cycle of the Japanese Beetle.

CONTROL OF JAPANESE BEETLE IN LAWNS[1]

By B. R. Leach, *Associate Entomologist*,
Bureau of Entomology, U. S. Department of Agriculture

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INTRODUCTION

When lawn or golf greens become heavily infested with the larvae (grubs) of the Japanese beetle it becomes necessary to kill the grubs before they ruin the sod or turf. The most satisfactory method of killing this insect in turf consists of treating the turf with emulsified carbon disulfide, diluted with water. The treatment is best applied in late summer, at which time the grubs are only about half grown and have not as yet injured the grass to any appreciable extent.

PREPARATION OF THE EMULSION

Two carbon disulfide emulsion formulae are herewith presented, each having special merits as discussed below:

Emulsion No. 1. The ingredients of this emulsion consist of 10 parts by volume of carbon disulfide[2], 1 part by volume of cold-water-soluble rosin fish oil soap and 3 parts by volume of water. Prepare the emulsion in a wooden butter churn (Fig. 5) or ice cream freezer as follows: place the soap and water in the churn and turn the handle for a few moments in order to obtain an even mixture. Then add the carbon disulfide to the mixture of soap and water in the churn and turn the handle for about two minutes or until the mixture emulsifies as indicated by the change in color and the cream-like consistency of the liquid.

This emulsion is valuable in that the ingredients are readily obtainable and easily emulsified with simple apparatus. This formula is recommended when the emulsion is to be used in lawn treatment immediately after mixing, as would in all probability be the case when the emulsion is made at home. The emulsion has one disadvantage in that on standing in containers for any length of time it has a tendency to separate or stratify and must be thoroughly shaken before being used for lawn treatment. Shaking large containers of emulsion is a laborious and uncertain process.

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[1] An extended account of the life history and habits of the Japanese beetle are given in bulletin 390 and directions for spraying fruit trees to control the insect are given in bulletin 406 of the Pennsylvania Department of Agriculture. Copies of either bulletin may be secured upon request.

The present bulletin has been prepared at the request of the Pennsylvania Department of Agriculture, at the Japanese Beetle Laboratory at Riverton, N. J., to meet the popular demand for authoritative recommendations for preventing injury to lawns by the Japanese beetle in its young stage. The Japanese Beetle Laboratory is the headquarters for the cooperative project between the Bureau of Entomology of the United States Department of Agriculture, the Bureau of Plant Industry of the Pennsylvania Department of Agriculture, the Bureau of Statistics and Inspection of the New Jersey Department of Agriculture, and the Delaware Department of Agriculture.

[2] Pure carbon disulfide is a colorless liquid insoluble in and heavier than water. It is readily volatile and the vapor is highly inflammable. It can be secured at most drug stores.

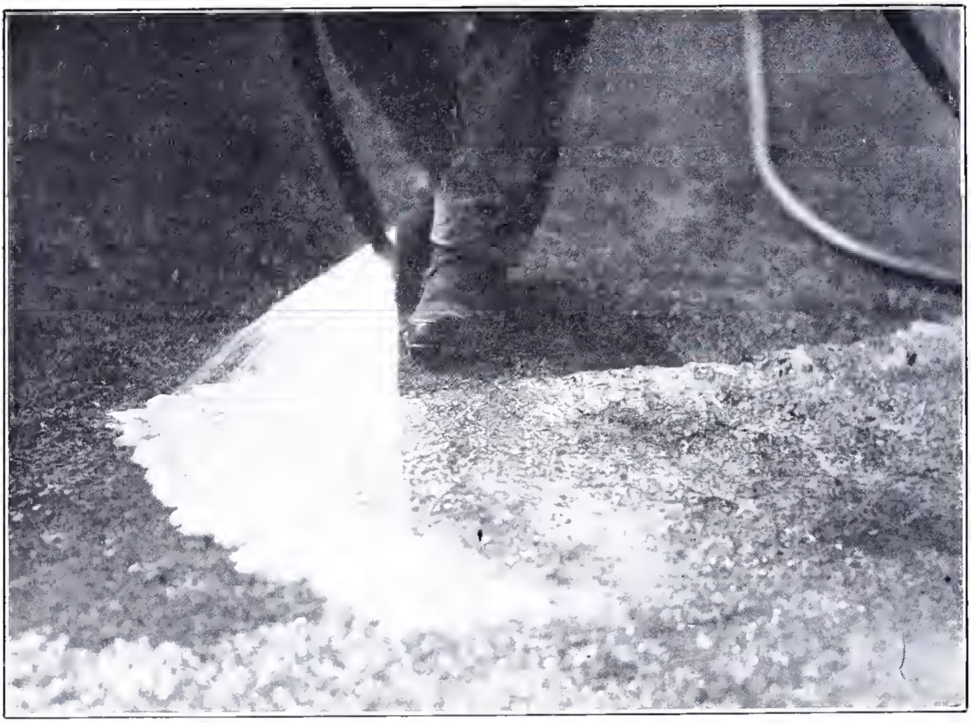

Fig. 2. Special nozzle in operation. (U. S. Dept. Agr.)

Emulsion No. 2. Make up a soap solution as follows: To 135 cc. of 7% sodium hydroxide solution, add 50 grammes of powdered rosin. Then add 450 cc. of water and agitate thoroughly. Add 50 cc. of oleic acid and again agitate thoroughly. The best grades (C. P. or U. S. P.) of sodium hydroxide, rosin and oleic acid should be used. Thirty parts of the above soap mixture is added to 70 parts of carbon disulphide and the mixture agitated in a churn until emulsification occurs.

This emulsion has the advantage of not separating or stratifying but very slightly when stored and is therefore the preferable one of the

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The writer is indebted to Mr. J. William Lipp, of the Japanese Beetle Laboratory, for the formula of this emulsion.

two for those buying the emulsion in large drums from commercial concerns, since no shaking of the containers is necessary.

Caution: Carbon disulfide is extremely inflammable and explosive and must be handled with the same degree of care as gasoline.

TREATMENT OF LAWNS

Equipment. The emulsion may be diluted in any container, varying from a watering pot or barrel pump to a large tank with engine and pump, depending in a measure upon the area of turf to be treated and the facilities available. It may also be applied by means of the mixing machine (Fig. 2) which will be described later.

Small lawns, such as ordinarily surround the average urban or suburban house, can be treated by the owners with ordinary home utensils. For this purpose a tub or barrel for mixing the stock emulsion and a watering pot with a coarse nozzle for applying the liquid to the turf are all that is necessary. Mix the carbon disulfide emulsion with water in the tub or barrel at the rate of one quart of the emulsion to 50 gallons of water, and apply the resulting liquid to the turf at the rate of one quart per square foot. For smaller amounts use one tablespoonful of emulsion to one gallon of water. This amount cannot be applied all at one time to the turf without flooding. It will be necessary to water the lawn with the liquid up to the point where flooding and puddling is iminent, and then allow the liquid to soak in for a few minutes before applying the remainder of the allotted quantity. The nozzle of the watering pot should be held within a few inches of the ground during the operation so as to avoid as much as possible the loss of the toxic gas from the liquid.

In the event of a barrel pump being used the liquid may be mixed in the barrel, pumped out through a hose and applied to the turf by means of the nozzle shown in Fig. 3. Before mixing the carbon disulfide emulsion with water in the barrel, care should be taken that the latter is entirely clean.

TREATING LARGE LAWNS AND GREENS

Equipment. The method in general is indicated by the accompanying illustrations. The outfit employed for this work should consist of a motor truck or wagon upon which is mounted a tank with pump and regulator. (See cover page.) The main supply hose from the tank leads to a pipe, as shown, from which four leads of one-inch hose (each with a cut-off valve) carry the liquid to the green. At the end of each line of inch hose is a special nozzle, devised at this laboratory, for the specific purpose of properly flowing the liquid upon the lawn (Fig. 2). In other words, the liquid is not sprayed upon the green under pressure; it is poured or flowed on the turf.

Preparation of the Green for Treatment. Since the liquid is applied at the rate of one quart per square foot of turf, it follows that each tank of liquid will treat an area of lawns equal to four times the capacity of the tanks in gallons. As an example, suppose the tank holds 450 gallons of liquid. This amount of liquid would therefore treat 1800 square feet of lawn. In practice, therefore, beginning at one side of the green, strips of lawn the length of the green, each comprising an area of 1,200 square feet, are laid out and marked by lines of coarse twine, and a line of hose, with nozzle attached, is then laid the length of each of the three strips, as shown in Fig. 6. Everything is now in readiness to apply two successive tanks of liquid to the 3,600 square feet of the green marked out as above. The size of the areas of turf so lined out would depend entirely on the size of the tank.

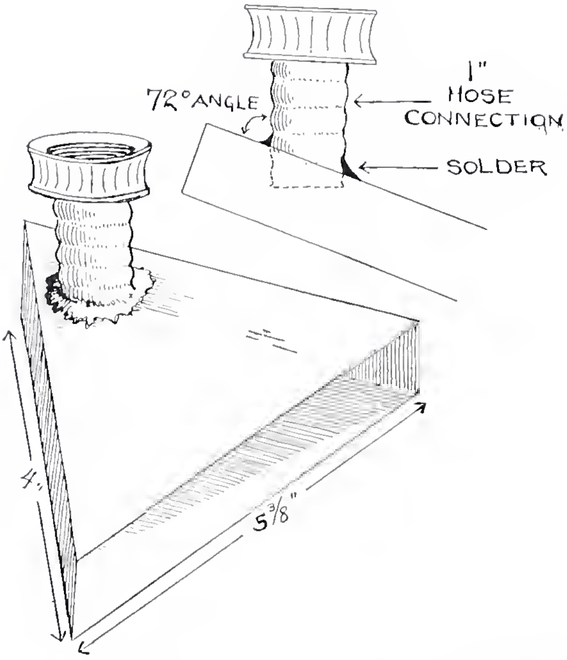

Fig. 3. Working drawing of the special nozzle for treating golf greens and lawns. (See Fig. 2 for nozzle in operation.)

Applying the Liquid to the Turf. Under the above arrangement the 3,600 square feet area of lawn is divided into three equal parts.

Each part is treated with 300 gallons of liquid by a workman who confines his efforts to his own strip of turf (see cover page). By this method the liquid is applied in an orderly and systematic fashion and the chance of uneven distribution of the liquid is reduced to the minimum. Furthermore, any faulty work on the part of the individual workman, resulting subsequently in poor grub kill or burning of the lawn, can be corrected.

Manipulation of the Nozzle. The special nozzle is shown in operation in Fig. 2 and on cover page. It will be observed that the liquid flows from the nozzle in a fan-like stream, and that the nozzle is held about 4 to 8 inches from the ground. The operator, beginning at one end, slowly moves over his strip of lawn, from side to side, covering the ground with a layer or coat of liquid, avoiding puddling or excessive run-off, and taking care not to leave any untreated streaks. The experimental work has indicated that, in applying the liquid at the rate of one quart per square foot of turf, it is advisable to regulate the speed of application so that the workman will have gone over the strip once when the first of the two tanks of liquid is emptied. While the tank is being refilled the turf will have absorbed the liquid already applied sufficiently so that the second tank can be applied in the same way as above without excessive run-off or puddling. In this respect, *the danger from applying another layer of liquid before the previous one has been absorbed by the turf cannot be emphasized too strongly. Severe burning will result if care is not taken in this respect.*

On the other hand, while too heavy coating of the turf must be avoided, the operator must not swing to the opposite extreme and apply several light coatings. There will be no burning under the latter conditions, but the grub kill will be unsatisfactory. Under the circumstances, it seems advisable to follow a medium course by applying the one quart per square foot in two even coats.[1]

Treating Turf with the Mixing Machine. Treating turf with carbon disulfide emulsion by means of a tank and pump outfit, as described above, is a very efficacious method as far as the attaining of the desired result is concerned, but the necessary apparatus is expensive and clumsy in actual use. These aspects of the case were responsible for the experimental work carried on by Mr. G. Gordon Urquhart, a chemical engineer of Philadelphia, in cooperation with this laboratory, resulting in the invention of the machine illustrated in Fig. 4.

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[1] To test the turf as to whether it is in condition to receive another coating of liquid, press the foot upon the turf; if the liquid oozes out under the pressure of the foot, the turf should be allowed to drain until this condition no longer exists.

The machine is based upon the principle that a stream of water flowing under pressure through a pipe is capable of creating a suction. Under this condition the water from the hydrant enters the machine through the hose on the right hand side and passes through the pressure regulator and water meter. It then flows through a constructed pipe, making a jet, which shoots across an enlarged chamber and out through the pipe and inch hose. To this enlarged chamber is attached a thin tube ($\frac{3}{16}''$ diameter), with needle valve, which extends down into the pail containing the stock carbon disulfide emulsion. The jet of water, shooting across the enlarged chamber, creates the suction which draws up the carbon disulfide emulsion from the container into the enlarged chamber where it mixes with the main body of water and flows out through the inch hose to the green. The needle valve is so adjusted by the operator that one quart of stock emulsion is sucked up by each 50 gallons of water passing through the machine.

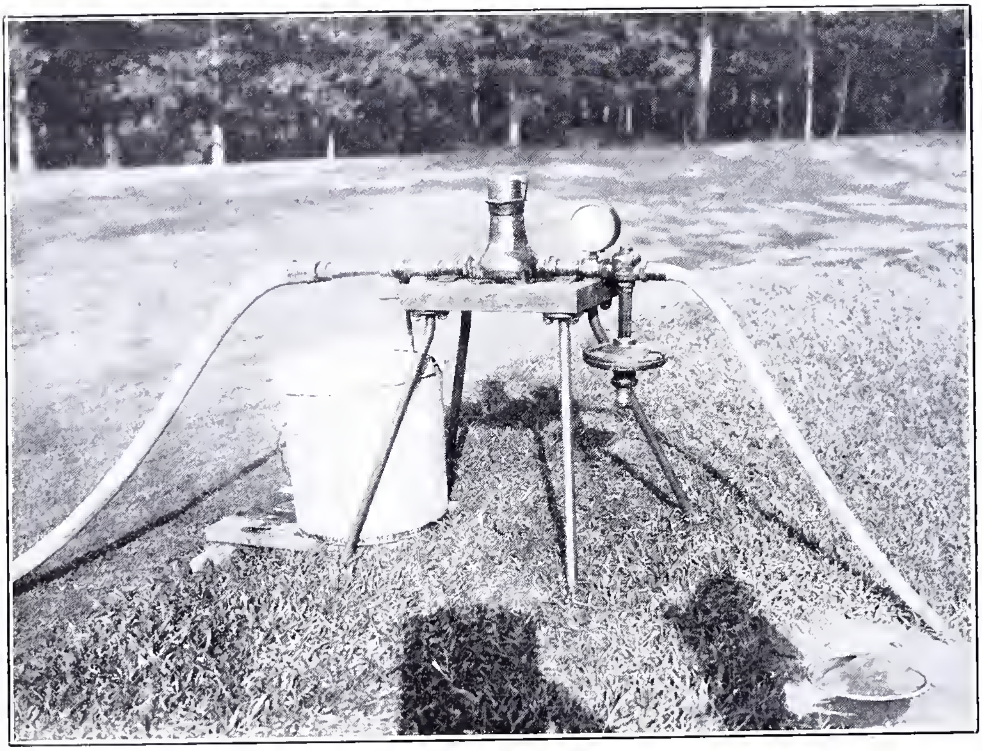

Fig. 4. The mixing machine set up on the side of the green. (U. S. Dept. Agr.)

This machine, as now manufactured, is obtainable for less than $100.00. Its value is apparent since it does away with the necessity of expensive tanks and pumps and effects a 75 per cent reduction in the expenditure for rubber hose. Two men, with this outfit, can do the work requiring five men with the tank and pump method.

Fifty golf greens in New Jersey were treated in 1924, using this type of machine, with very satisfactory results. As a result of the season's experience certain minor changes and adjustments have been made which should contribute toward simplicity and smoothness of operation in practice.

Adjusting the Machine. Set the machine up alongside the green or lawn to be treated and connect it to the hydrant or faucet. Turn on the water and determine the pressure by means of the gauge. Now tighten the pressure regulator so that the pressure drops ten or fifteen pounds, thus insuring a steady pressure and uniform flow of water regardless of fluctuations in the water supply. Close the needle valve. Lift up the machine and place a gallon measure under the thin suction tube or pipe. Pour a quart of water into the measure. It is cheaper and better to use water alone than carbon disulfide emulsion for the adjustment of the machine. Now open the needle valve to any tentative degree, taking the reading on the water meter at the time and then allow 50 gallons of water to flow through the machine. If the quart of water in the can is sucked up, before the 50 gallons have run through the machine, close the needle valve in proportion and test the adjustment with another quart of water. A very little experience with the machine will enable one to adjust the needle valve so that one quart of liquid is sucked up for each 50 gallons of water flowing through the machine.

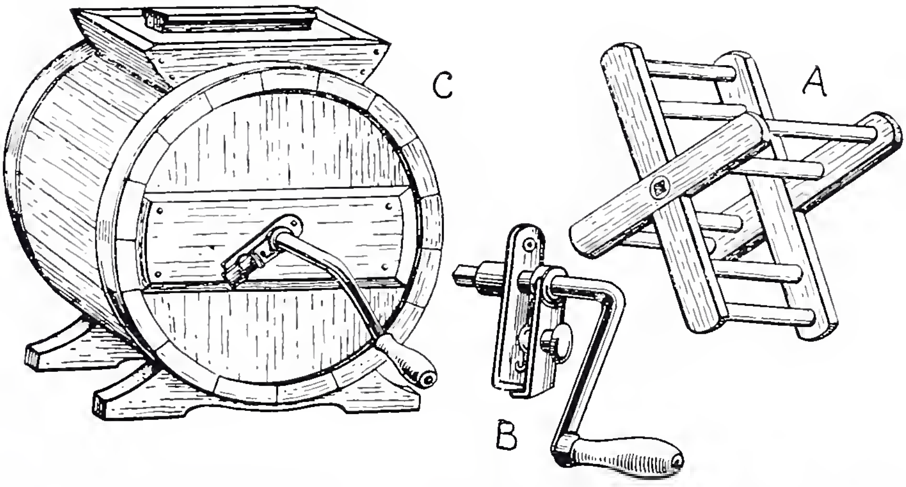

Fig. 5. A desirable type of churn for use in the preparation of carbon disulfide emulsion. (U. S. Dept. Agr.)

Applying the Liquid to the Lawn or Green. Having adjusted the machine as above, replace the gallon measure with the large covered container (Fig. 4) and place therein a gallon or two of stock carbon disulfide emulsion. The machine is now ready for the application of the liquid to the green.

The method of lining out the green or lawn for treatment with the machine is shown in Fig. 6. Having placed the machine in the position A, with one hundred feet of inch hose attached, it is possible to treat the area A B C when the distance A C is less than 100 feet. Having treated this area the adjoining section of turf is treated by moving the machine to the position D. The distance from the hydrant to the machine is governed only by the quantity of pipe or ¾″ hose available, but it is not advisable to employ more than 100 feet of inch hose for delivery from the machine since longer lengths of hose create too great a back pressure upon the suction chamber.

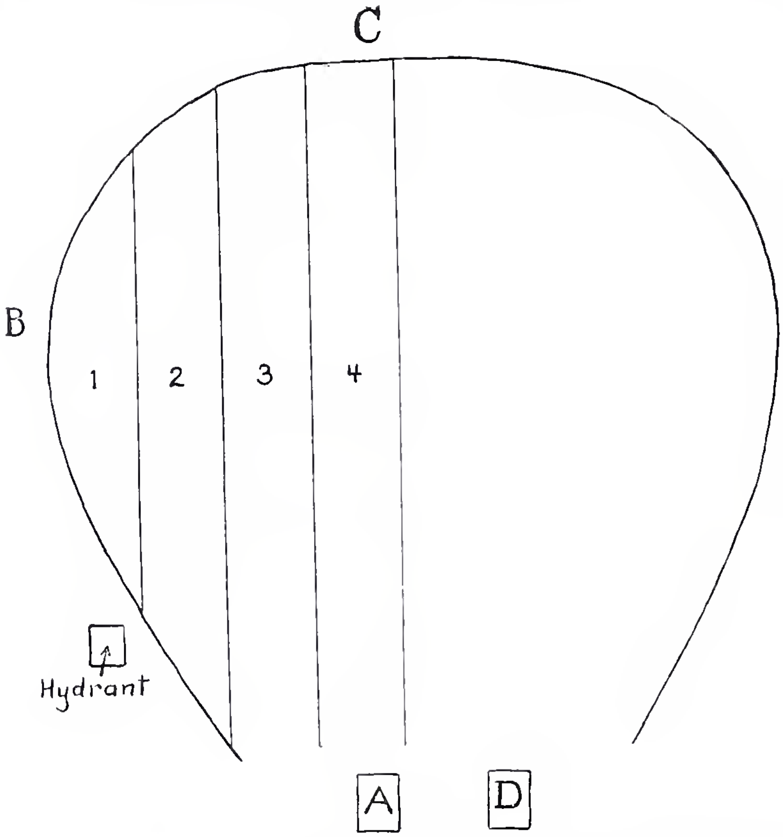

Fig. 6. Layout of a lawn or green for treatment with the mixing machine. (U. S. Dept. Agr)

The turf is best treated in strips about 10 feet wide, the strips being designated by lengths of coarse twine. Beginning at the left (Fig. 6), coat strip No. 1 with the liquid as described on page 7, applying an even coat and avoiding excessive flooding or run-off. When No. 1 strip is covered proceed with No. 2. If No. 1 strip has drained properly in the interval give it another and final coating. If No. 1 is not ready for the second coat of liquid proceed with the first coating of No. 3 strip. Following this procedure the application of the liquid is continuous and no time is lost through waiting. Two coatings made in this fashion will be found to closely approximate an application of 1 quart per square foot of turf. It can be checked by comparing the liquid going thru the meter with the area treated.

Two men are necessary for the proper operation of this machine. One man will be occupied in handling the hose and nozzle in connection with the actual application of the liquid to the turf. The duties of the second man will consist in keeping the machine supplied with stock carbon disulfide emulsion, marking the boundaries of the strips of turf with the lengths of string and assisting the first workman in handling the 100 feet length of hose.

EFFECT OF TREATMENT UPON GRASS

Various grasses have been treated during the course of the experimental work, including clover, red top, low spear-grass, fescue, German and creeping bent. All these grasses withstood the treatment when the turf was not in a weakened condition caused by grub feeding on the grass roots. The only injury encountered in treating vigorous turf consisted in surface burning in hot weather and injury to low spots in the turf where the liquid puddled. For this reason it would seem advisable to have the greens or lawns in the Japanese beetle area so graded that these hollows are obviated. As stated above, the treatment of vigorous turf in hot, sunshiny weather sometimes results in a browning of the blades of grass, thereby giving the green or lawn a burnt appearance. If watered daily, however, the crowns of the grass soon send up new shoots and the green assumes a normal appearance within two weeks. Treatment in extremely hot weather is therefore not advised, except when the grubs are threatening serious damage to the turf if treatment is delayed, in which even the burning due to the treatment under these adverse conditions will be the less of the two evils.

When the treating of infested turf is delayed until it is in a weakened or damaged condition due to grub feeding, the effect of the treatment upon such turf is an entirely different matter. In these instances the turf have little or no resistance to the chemical. It should be top dressed and reseeded in a few days after treatment.

Treating normal turf with emulsified carbon disulfide also results in a pronounced stimulation in the growth of the grass. Vigorous growth and a deepening in the color of the grass is apparent a week or ten days after the treatment.

COST OF THE TREATMENT

It will cost approximately twenty dollars for the emulsion and labor to treat a green or lawn 80 feet wide by 90 feet long, the cost of the emulsion accounting for about two-thirds of this sum. The emulsion may be purchased for about 15 or 16 cents a pound in 500 pound lots, or the ingredients may be purchased separately and emulsified at home. In the latter event the saving is not commensurate with the amount of work and trouble involved.

CARE OF THE TURF AFTER TREATMENT

The turf should not be disturbed in any way for 36 to 48 hours after treatment. By the end of that period the excess water has usually drained away and the turf can be top dressed or otherwise cared for.